EDITORIAL

The Role of Systems Factors in Implementing Health Information Technology

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This issue of the *Journal of General Internal Medicine* (JGIM) includes a variety of important articles on the different dimensions of the role of health information technology (HIT) in medical practice. Several of the articles provide key insights into issues which are important in the effective implementation of HIT to change practice. We have noted several key themes across this issue, which provide insights into future clinical and research directions needed to ensure the successful implementation of HIT to change practice. We start by taking a “system” perspective and then note some of the detailed factors affecting HIT implementation.

An underlying theme of these articles is that HIT must be an integral part of the health care system and that being aware of the “system”, its properties, its time-varying characteristics, its complexity, and the surroundings in which the system exists strongly influences the success of HIT. For example, Leu et al.¹ makes the key point that “Successful adoption of health IT requires an understanding of how clinical tasks and workflows will be affected; yet this has not been well described”. That is, the probability of a successful HIT implementation is greatly increased by a well-characterized, deliberately designed host set of health care processes. Furthermore, expectations of HIT within a health care process must be realistic with respect to benefits and costs.

White² makes several fundamental observations about the health care system and HIT. He notes that “so much medical care involves acquiring, sorting, categorizing, exchanging, imparting and using information for treatment decisions actions...”. Although health care has many dimensions beyond information processing, the key role of information to health care provides an inescapable first-principles argument about the enormous potential system benefits of HIT. However, many of the articles in this issue address the fact that apportioning these potential benefits and how they are experienced over time are significant system factors affecting HIT implementation.^{3–5} Consider the articles discussing electronic prescribing.^{3,4} The aggregate sys-

tem benefits are well established in terms of, for example, reducing adverse drug events, but the costs of the implementation are borne by those who implement and use e-prescribing. These costs are both financial and otherwise. As a result, even when e-prescribing implementation is financially underwritten the perceived and real non-financial costs can cause failure.^{2–4,6} However, the reporting of programs in Massachusetts⁴ and New Jersey³ that are piloting the apportionment of system-wide benefits to practices in the forms of implementation assistance are an encouraging connection of system-wide benefits to component parts (practices).

Time is another important system consideration in HIT implementation. The cost of HIT implementation is immediate as processes are affected, initially unfamiliar technology must be mastered, and the complexity of health care invariably dictates troublesome exceptions to initial implementation. Conversely, benefits are the least obvious at the beginning of an implementation and usually accrue slowly as the system integrates HIT. Fung et al. paints an encouraging, but realistic picture, of the future of HIT by studying the VA, one of the largest, earliest, and most complete investors in HIT.⁵ A key conclusion could have been drawn from manufacturing IT or financial IT, namely “... CCRs (HIT) need to be developed and implemented with a continual focus on improvement based on end-user feedback.” Indeed the complexity of health care may make the need for iterative and continual refinement of HIT even more imperative to success. This point is well made by the articles describing decision support tools for specific disease conditions.

White² makes another point about time as a system consideration influencing HIT. Namely, he cites the additional requirements placed on the health care system such as disease surveillance, which HIT can facilitate. In general, the trend toward increasing requirements on the health care system from demographics, demands for increased care, etc. point toward the need for a paradigm shift because there will come a time when the current paradigm will fail. HIT offers scalability and additional qualitative benefits, if the hurdles to implementing it can be overcome.

The articles in this issue provide clear evidence that implementation of HIT is challenging and needs to be fully informed by the local context and an understanding of the system. As mentioned above, despite widespread advocacy for electronic prescribing as a tool to improve patient, safety, only about one fifth of practices currently have implemented this technology.³ Crosson et al.³ used observational and interview

techniques to collect data on prescription-related clinical workflow, information technology experience and expectations in a sample of physicians and staff members in 12 practices scheduled for implementation of an e-prescribing program.

As often observed in practice, but rarely reported in the literature, implementations of HIT fail despite the best intentions, major financial investments, and considerable effort. Here five practices fully implemented e-prescribing, three installed with only some prescribers or staff members using the program, two practices installed and then discontinued use, and two failed to install. Practices successfully implementing exhibited greater familiarity with the technology's capabilities and had more limited expectations about the likely benefits. In contrast, unsuccessful practices had a limited understanding of its capabilities, expected significantly increased clinical care efficiencies and reported challenges with the implementation and adequate technical support. Thus, careful planning, assessment of the local context, and ongoing integration of the information system into clinical workflow and practice is needed.

Leu and colleagues conducted a qualitative study of community health centers and health networks using a variety of different HIT solutions (vendor-supplied, registry systems and locally developed) to better understand how HIT functions within the clinical context of different ambulatory practices.¹ They identified 6 primary clinical domains, which characterized the context in which HIT is used: intraclinic communication, patient education and outreach, interclinic coordination, medication management, and provider education and feedback. The paper also identifies many potentially effective strategies, which should be investigated further, such as electronic solutions to keeping problem and medication lists synchronized during care transitions and using medication dispensing data from claims databases to improve their medication refill and reconciliation processes.

Further, they identified key systems functions needed for optimal use in clinical practice, such as identification of patient populations (or subsamples), data quality and maintenance, identity reconciliation, migrating historical data, assignment of provider panels, local system configurability, standardization of measures, and generating reports. Similarly, in a large multisite focus group study of 18 medical centers, Lyons and colleagues demonstrated that different stakeholder groups hold different perceptions of the barriers and facilitators to using HIT to implement evidence-based practice.⁶ Thus, an information system needs to be adapted during design, implementation, and ongoing maintenance to address the unique characteristics of the local context and continually assess and meet the needs of its providers, patients, and managers.

Leu and colleagues created a series of process diagrams describing the clinical context in which HIT systems are used. As they note, these diagrams may be useful in comparing different HIT solutions and in identifying challenges to the effective clinical use of HIT. Further, they point out that this work can help design curricula about the role of HIT in practice and plan how it may be used to evaluate provider conformance to practice standards. Perhaps an even more important role may be to help practice managers identify areas where there is considerable variation in practice or multiple workarounds, which would be ideal targets of further research or a potential

system redesign project. Leu et al.³ conclude that underlying workflows for the domains must be fully operational and further, that understanding clinical context is a necessary precursor to successful deployment of HIT. This study provides further evidence of the importance of understanding the local context and adapting implementation of HIT to overcome the local barriers. Furthermore, it adds to the literature calling for more effective integration of HIT into workflow as one of the top priorities in allowing effective implementation.

The article by Fung and colleagues approach this issue from a quantitative perspective, in a national written survey of the use of computerized clinical reminders of generalist providers.⁵ The study was conducted in the Veterans Health Administration, which is an integrated delivery system with longstanding implementation of an electronic health record and provider order entry. The authors showed that factors such as self-efficacy, design and interface, integration with workflow/work load, and training were associated with a more favorable global assessment of the reminders. This study suggests that health systems need to consider end-users perceptions in the development and implementation of computerized clinical reminders. Fung and colleagues also identified the need to better integrate clinical decision support into workflow.

These important articles, when interpreted in the developing literature in this area, point to several opportunities.^{6,7} More systems could use the tools of human factors engineering, system redesign, and implementation science in planning for, carrying out, and assessing the impact of implementation of HIT systems in their practices. A real challenge for our field is for researchers with these areas of expertise and health systems managers with such needs to invest the time needed to learn to work together, prioritize and support this crucial applied (local) research and development to meet the needs of the health system on an ongoing basis.

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